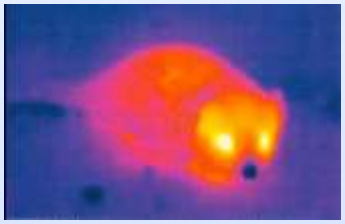
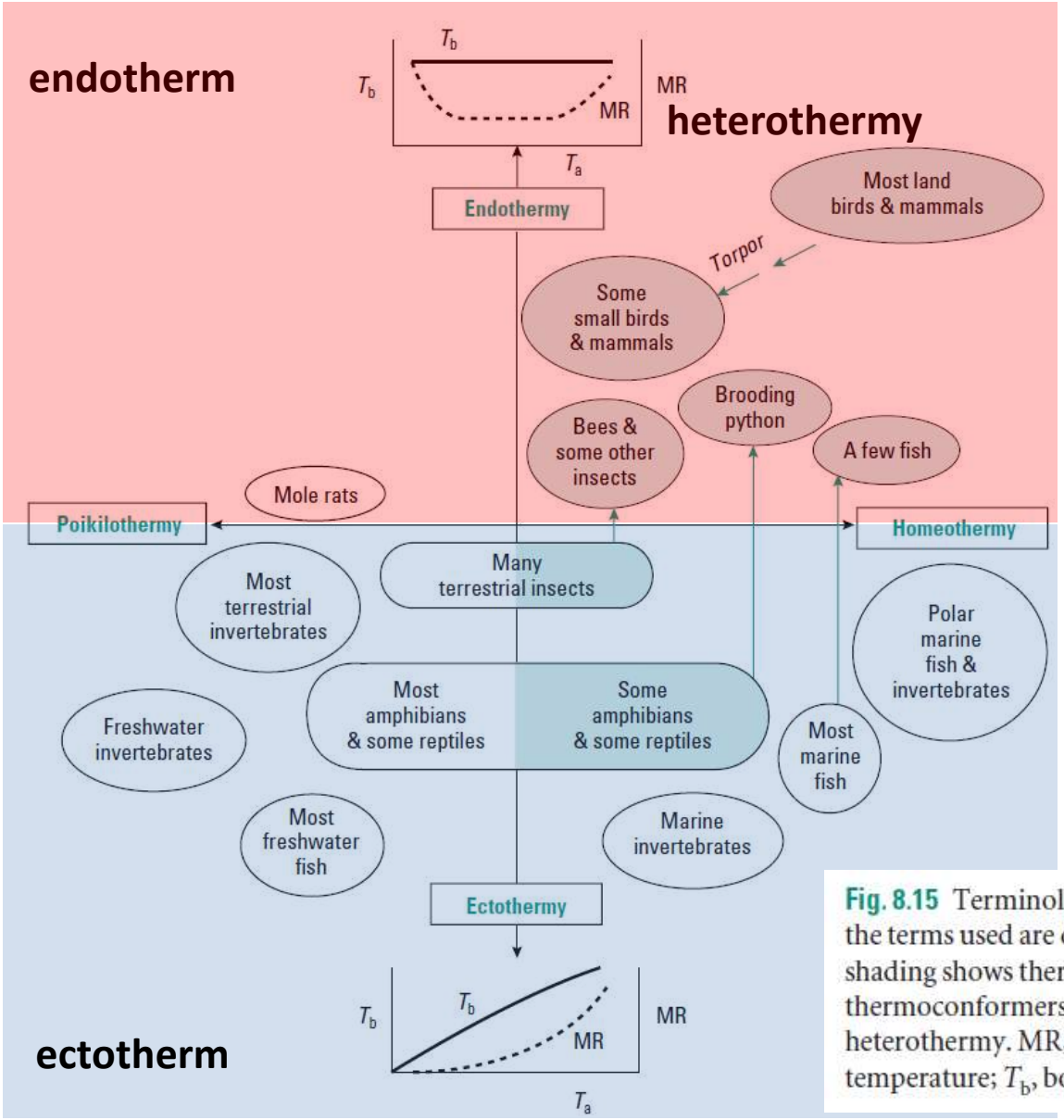
1. Thermal terminologies and strategies

Terminology surrounding body temperature

		Useful?
"cold-blooded" an animal that feels cold to touch	"warm-blooded" an animal that feels warm to touch	Terms are subjective - recommend you never use them!
"**poikilotherm**" these animals have a variable body temperature, usually depending on the environment	"**homeotherm**" these animals have a constant body temperature, usually depending on the environment	Terms are somewhat descriptive, but exceptions like ice-fish and torpid mammals confuse their usefulness
ectotherm temperature is determined by heat exchange with the environment (e.g. heliotherms, thigmotherms)	**endotherm** temperature is determined by heat produced by the animal and not by the environmental temperature	Terms describe the mechanism determining the temperature of an animal and are the best to use (but not perfect)

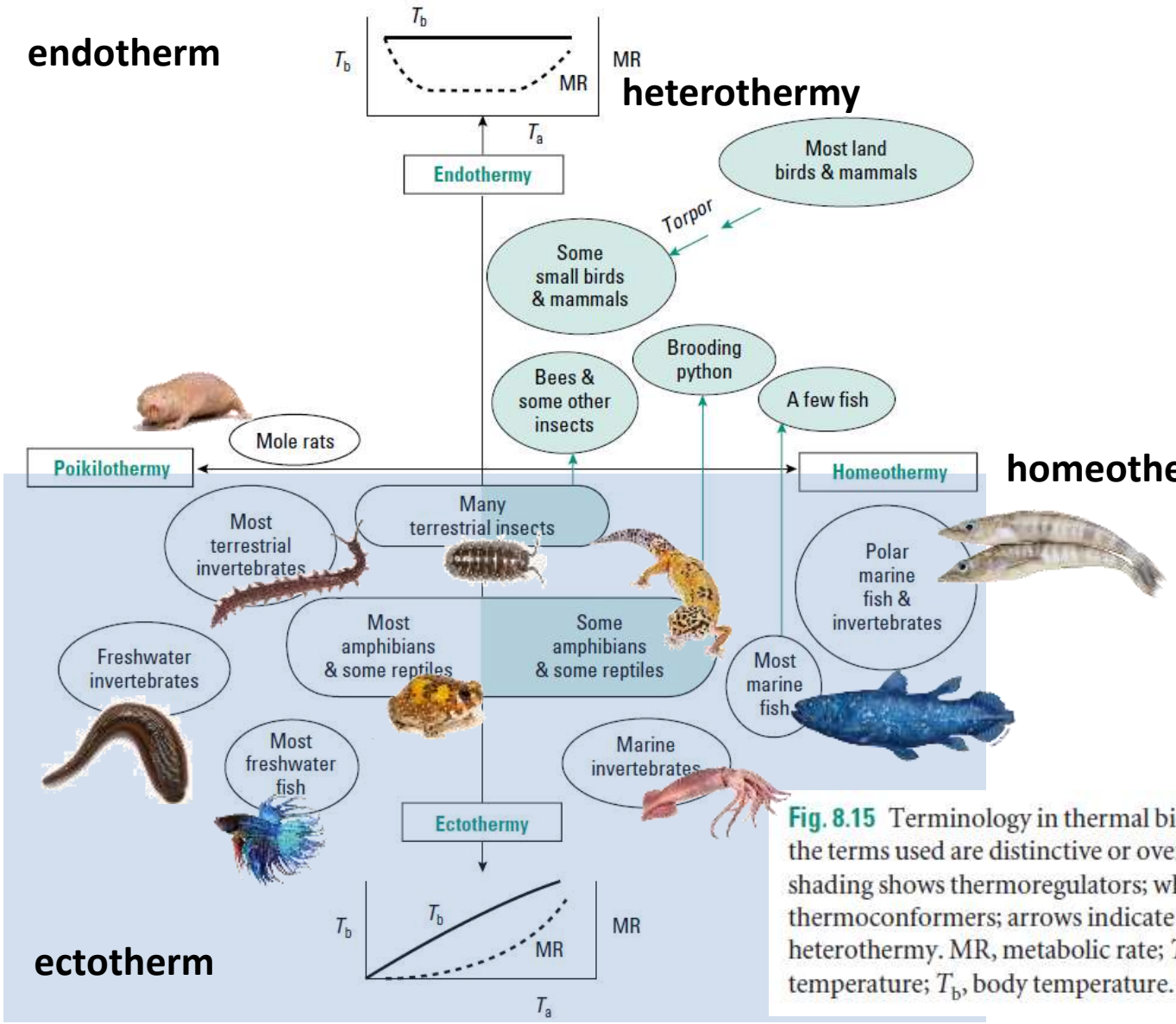
Complexity of thermal patterns



Can be achieved passively or actively

Fig. 8.15 Terminology in thermal biology–how the terms used are distinctive or overlapping. Green shading shows thermoregulators; white shows thermoconformers; arrows indicate temporal heterothermy. MR, metabolic rate; T_a, ambient temperature; T_b, body temperature.

Ectothermy



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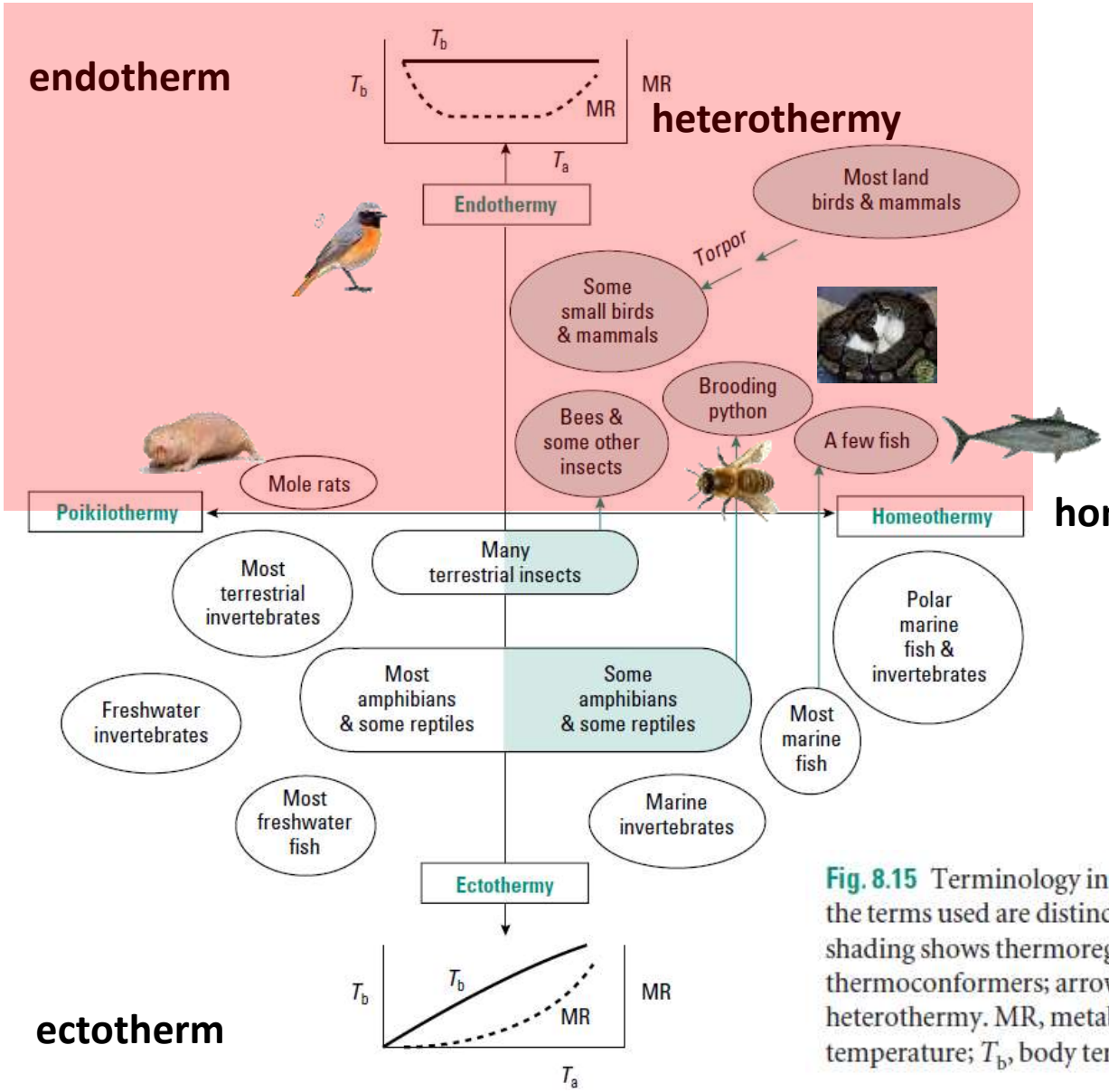
Endothermy



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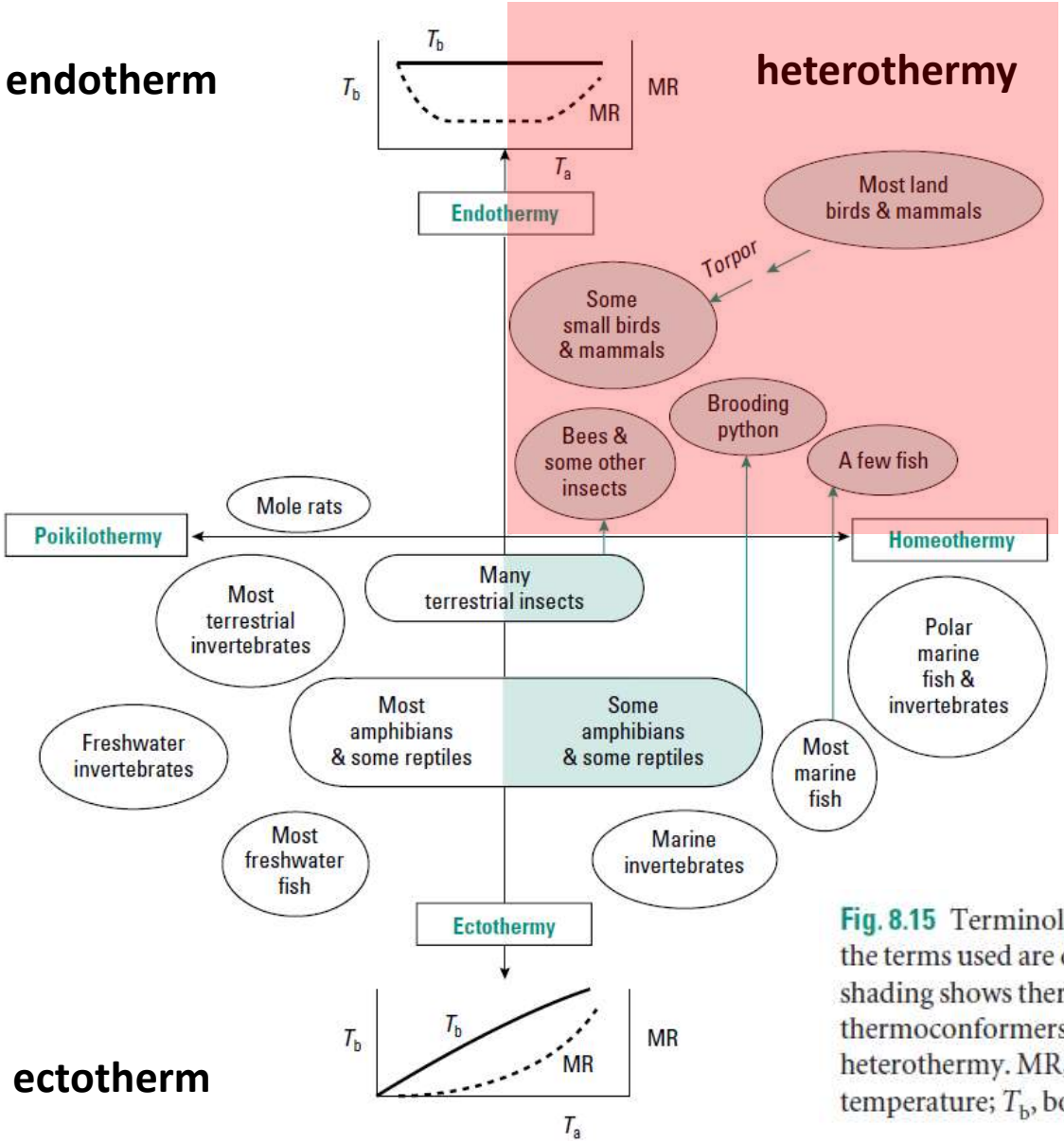
Typical active body temperatures of ectotherms and endotherms

	Ectotherms		Endotherms	
Habit	Group/species	T_b	Group/species	T_b
Aquatic	Marine deep-water fish	4–6	Fur seal	38
	Marine surface fish	5–10	Whale	36
	Temperate riverine fish	5–15		
	Reef fish	20–28		
	Tropical turtles	29–35		
	Warm temperate turtles	20–25		
Amphibious	Alligator in air	32–35		
	Alligator in water	20–35		
	Bullfrog tadpoles	22–30		
	Bullfrog adults in air	22–28		
Terrestrial	Blowfly	22–29	Man	37
	Flour beetle	25–30	Small rodents	35–37
	Bumble-bee (flying)	35–39	Bats	35–39
	Carpenter bee (flying)	38–42	Echidna	31
	Housefly (flying)	30–33	Armadillo	34–36
	Housefly larva	30–37	Chicken	40
	Chicken louse	38–42	Dove	39–42
	Temperate caterpillar	20–28	Owl	38
	Semitropical caterpillar	25–35	Zebra finch	41–42
	Tropical lizard	28–36		
	Desert iguana	36–41		

Heterothermy (variable Tb)



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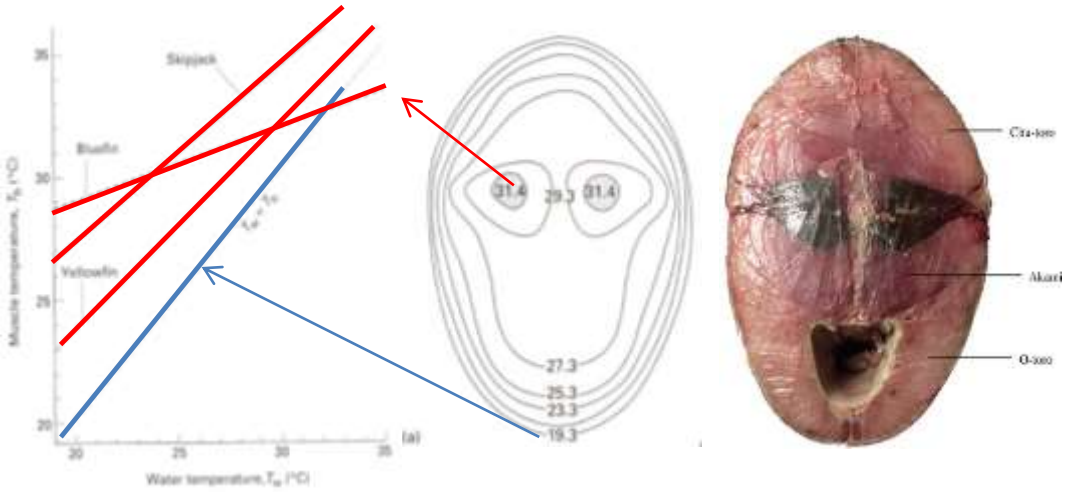
Regional endothermy characteristic large aquatic ectotherms

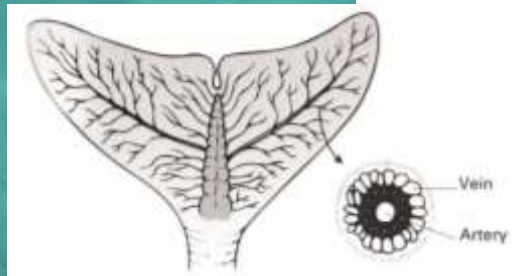
- Animals can have different temperature zones within their bodies
  - Fast, active large fishes (tuna, mackerel, bonito, billfish)
  - Large sea turtles (leatherbacks)
  - Lamnid sharks (white, mako, porbeagle)

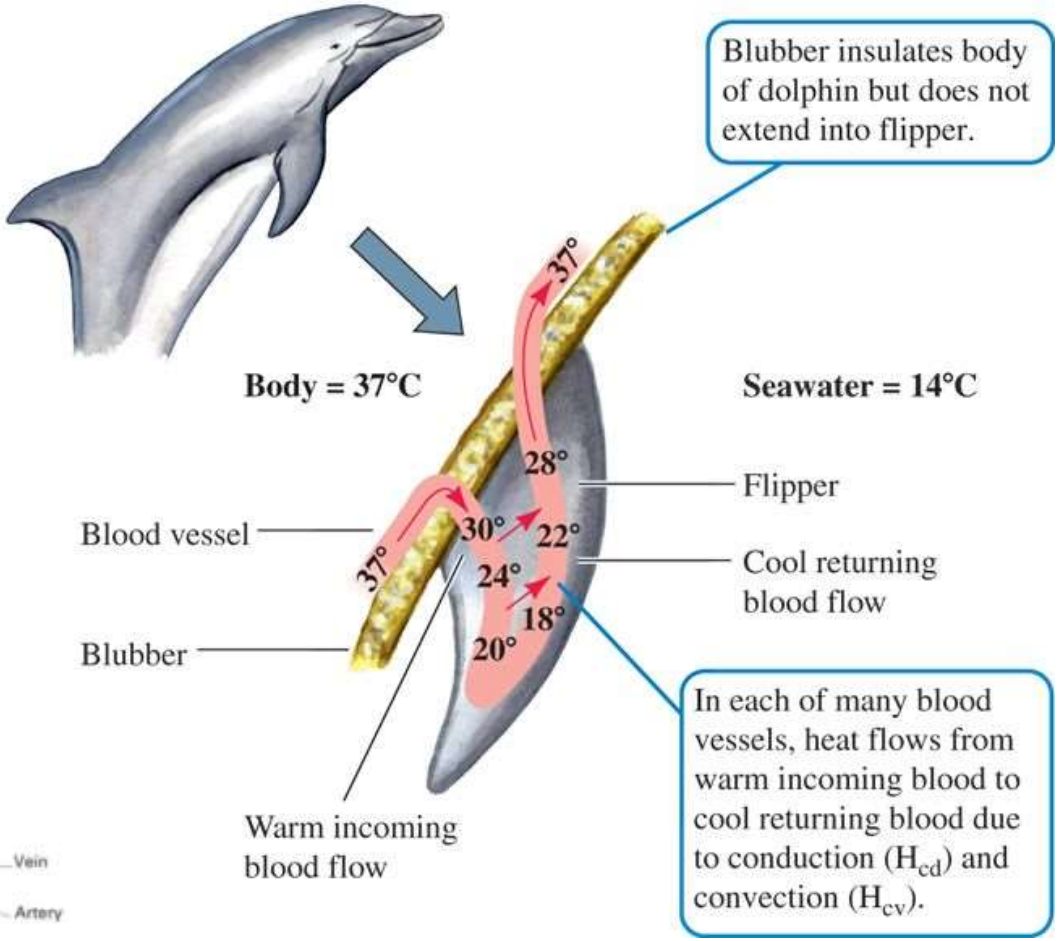


Regional heterothermy is also possible

- Occurs in cold environments, where extremities would otherwise be much cooler than the core temperature

e.g. counter-current heat exchange in dolphin fins and flippers

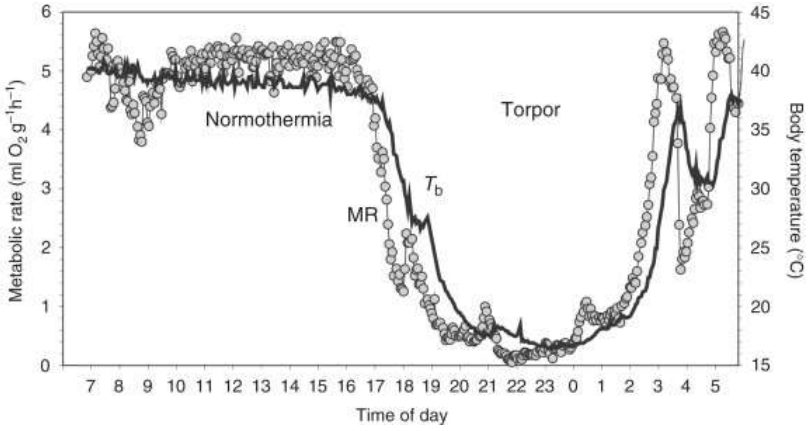




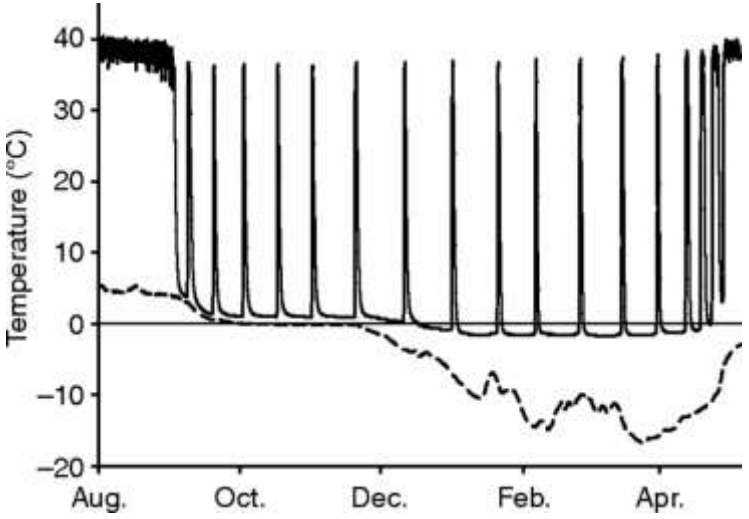
…as is temporal heterothermy

- Mammals and birds

Torpor


Normothermia
Torpor
T_b
MR
Metabolic rate (ml O_2 $g^{-1}h^{-1}$)
Body temperature (°C)
Time of day
0 1 2 3 4 5 6
15 20 25 30 35 40 45
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 0 1 2 3 4 5

Hibernation



Size affects thermal strategies

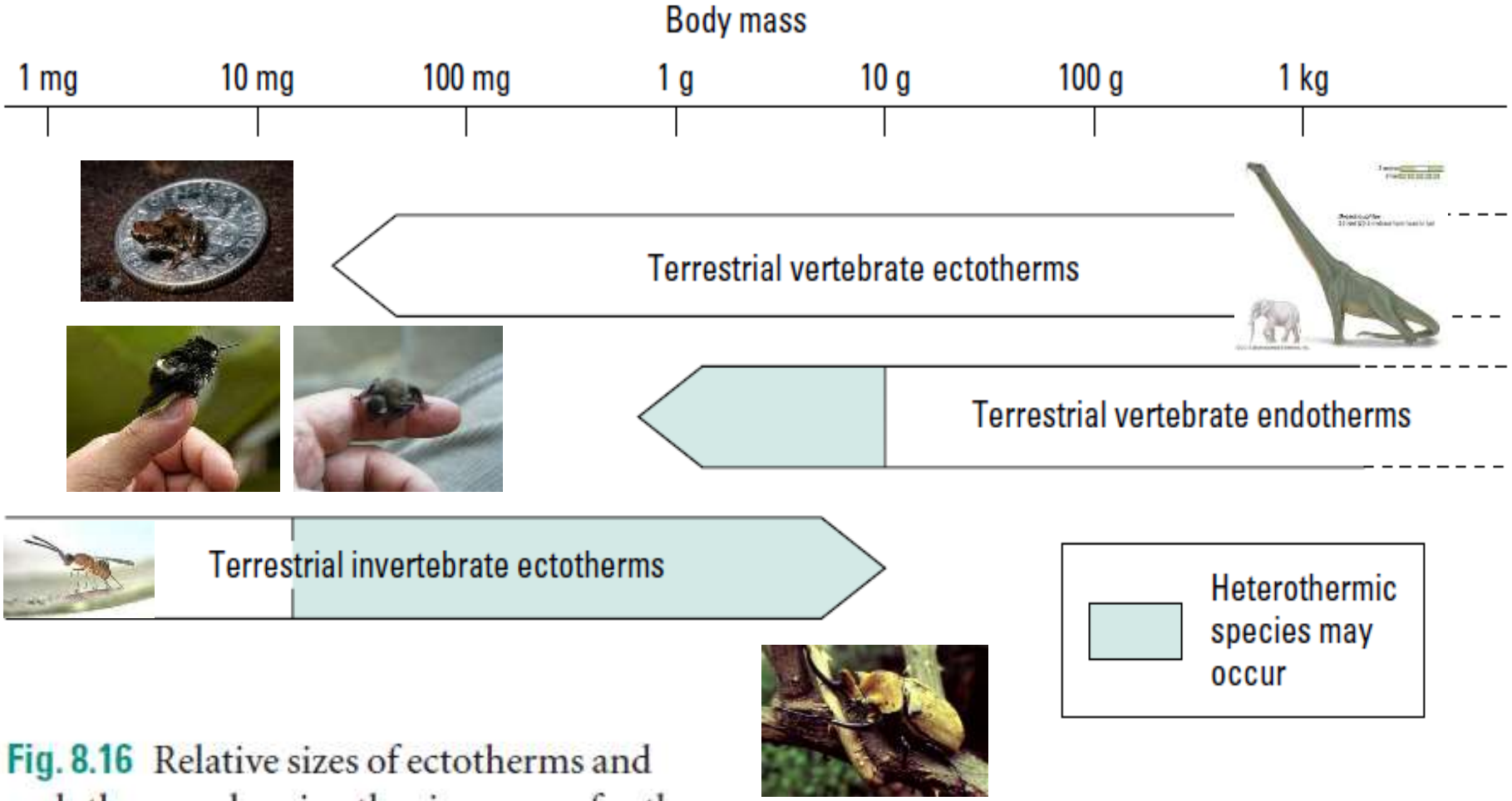


Fig. 8.16 Relative sizes of ectotherms and endotherms, showing the size ranges for the occurrence of temporal heterothermy.